School of Chem. Lib.

BULLETIN of the
ATOMIC SCIENTISTS . . .

VOL. 1 MARCH 15, 1946 NO. 7

Military or Civilian Control Of Atomic Energy?

The controversy "should atomic energy in America be under military or civilian control" has been brought to a showdown in the Senate Special Committee on Atomic Energy.

On the extreme militaristic side, there is Senator Eugene D. Millikin of Colorado who believes that even General Groves favors too much civilian influence. But in justice to General Groves, his scheme of an Atomic Energy Commission containing four military among its nine members with an active officer as administrator, can be relied upon to bring about complete military control.

The argument in favor of leaving research and development of atomic energy in the hands of the military goes as follows: "The atomic bomb is the most powerful weapon in existence. The applications of atomic energy to peacetime industrial processes can be postponed without endangering our national economy. With the world political situation as it is, we must give first priority to the military problem, and this can best be achieved by leaving the control of atomic energy in the hands of the military. This will ensure the maximum production of atomic weapons in America, prevent leakage of our atomic bomb secrets to other nations, and thus delay the atomic rearmament of our potential enemies."

This argument is fallacious. In the first place, it is not true that the world political situation is independent of our policy on atomic energy; in the second place, it is not true that the best way to ensure our continuous superiority in atomic armaments is to put the military in full control of research on atomic energy.

For the present state of mutual suspicion and fear between the wartime Allies is to a considerable degree the result of our failure to provide a clear lead in dealing with atomic energy. The international repercussions of the establishment of a permanent military control over atomic energy in America may well be disastrous for the cause of peace. Some politicians may view this step merely as a warning to the Russians, as an additional show of toughness in dealings with the Soviet Union. However, putting a law on the statute book will be taken by the world, not as a tactical step, but as a part of a long-range policy. International tensions come and go; but policies which have crystallized out in the form of laws or treaties remain. Permanent military control of atomic energy in America will signify to the world that America is basing its long-range policies on the assumption that a new war is inevitable, and this will help to make it inevitable.

While making the prevention of a new war more difficult, military control will not assure our continued advantage over the rest of the world in atomic armaments (and in scientific war potential in general). The Army will inevitably put emphasis not on creative research, but on building the largest number of atomic bombs of the existing type and protecting the secrecy of the present processes by strict security regulations, and other police methods.

If we expect a war this year or next year, this unrealistic attempt to perpetuate a momentary advantage will be of little avail, but will do no particular harm. But beyond this short term, this policy bodes ill for our security (as far as security can at all be obtained by maximum striking power). It is already depriving the atomic bomb laboratories of their most valuable brainpower. The really good scientists feel that their effort will be wasted if they are forced to work under the conditions of secrecy and compartmentalization, without the benefit of free exchange of ideas. Research laboratories which are run in this way will soon lapse into routine work. The importance of secrets that can be safeguarded by military supervision of science is widely exaggerated in the public mind. As repeatedly pointed out by informed scientists, and confirmed by engineering experts who have participated in the building of our atomic bomb plants, the delusion that we are safely protected by a secret stock of atomic bombs and an esoteric knowledge, which we share with nobody, may easily become a "scientific Maginot line."

Secrecy regulations, which military mentality is likely to force upon fundamental scientific research, will cause a paralysis of scientific progress. This paralysis will spread from governmental atomic bomb laboratories to all laboratories working in the nuclear field. The necessity may arise of establishing secret courses in our universities, leaving the majority of students in ignorance of basic facts of their science. With nuclear physics as an opening wedge, the same disintegration may permeate the fields of bacteriology, medicine, and other sciences all of which may be used in the next total war.

Since public opinion does not distinguish between science on the one hand, and technology (in which "secret processes" are common), on the other hand, it is likely to consider the opposition of scientists to military rule and compartmentalization only as a selfish fight for a comfortable way of life, or as the defense of certain liberal ideals, which have to be scuttled in the face of the "hard facts of life." What may be scuttled in the process, is America's leadership in scientific and technological developments, decisive for its future position in the world.

But, it may be argued, the Senate Committee did not follow General Groves and Senator Millikin. By a vote of 10:1, it has accepted on March 12 the "compromise" proposal of Senator Vandenberg:

"There shall be a Military Liaison Board appointed by the President composed of representatives of the Departments of War and Navy, in such number as the President may determine. The commission shall advise and consult with the board on all atomic energy matters which the board deems to relate to the common defense and security. The board shall have full opportunity to acquaint itself with all matters before the commission.

"The board shall have authority to make written recommendations to the commission from time to time as it may deem appropriate. If the board at any time concludes that any action or proposed action of the commission, or failure to act by the commission, is inimical to the common defense and security, the board may appeal

(Continued on last page)

Can Air Or Water Be Exploded? . . . . . *H. A. Bethe*

There has been much public discussion as to whether or not atomic bombs can start a nuclear chain reaction in the atmosphere. Similarly, since the planning of the Navy tests, many thoughtful scientists have expressed concern about the possibility of the chain reaction in water. And at least one fiction story appeared which told in an impressive way of the end of the earth caused by a chain reaction throughout the solid matter of the earth.

This concern is, of course, very well taken, and it is necessary to examine in great detail the possible dangers of atomic bomb tests before carrying them out. Such considerations can be made with the help of existing nuclear theory without making any assumptions going beyond the range of well explored phenomena. The conclusion from the calculations is that there is no danger of a nuclear explosion in any substance naturally occurring on earth with any of the atomic bombs which have been developed or have been conceived on paper.

The most effective safeguard against unwanted nuclear chain reactions is the fact that all atomic bombs must carry a considerable amount of inert material, including the firing mechanism, the neutron reflector, and other parts which have a total weight many times greater than that of the active material. For this reason, the temperatures which can be transmitted to the material surrounding the bomb are very much lower than the temperatures existing inside the active material. It is well known that all nuclear reactions depend very strongly upon temperature, i.e., on the energy with which the various nuclei are moving against each other. A lowering of the temperature, therefore, means a great reduction of the probability of nuclear reactions.

THE BOMB AND THE STARS

The temperatures which can be produced in the air or water surrounding an atomic bomb of present construction are of the order of 1,000,000°, maybe somewhat more, maybe somewhat less. This is very much lower than the temperatures prevailing at the center of ordinary stars, which are of the order of 20,000,000°. We can, therefore, use the stars for comparison and can be sure that the nuclear reactions in the substance surrounding the atomic bomb will be less frequent than in the stars. Moreover, it is clear that the amount of inert material in the bombs could be reduced appreciably before we would attain in the surrounding material the conditions which prevail in the stars.

In normal stars the most important nuclear reactions are believed to be between protons on one side and carbon or nitrogen nuclei on the other. The reaction between protons and oxygen is less probable by a factor of about 10,000 at stellar temperatures, but even the reaction between protons and carbon is extremely slow, so that it would take several million years for the carbon in the sun to be consumed (if it were not regenerated in the actual stellar reaction cycle). A nuclear reaction which takes millions of years to be completed is certainly very far from being an explosion, at least by a factor 10^{14}. It will also be noted that neither in water nor in air are there large numbers of those nuclei which would cause one of the probable reactions, i.e., carbon and hydrogen, or nitrogen and hydrogen.

Another reaction the theory of which has been developed in detail, is the combination of two protons to form a deuteron with the emission of a positron during the collision. This reaction is simple enough to be treated with some completeness by present theory. It is favored by the fact that the two interacting nuclei have the smallest possible charge and have also a small mass (which facilitates leakage through the potential barrier according to the Gamow theory). On the other hand, the proton-proton reaction is made improbable by the fact that a positron must be emitted during the process in order to conserve the charge. It is well known that all processes involving the emission of negative or positive electrons are exceedingly improbable as measured by nuclear standards. The calculation of the rate of this process shows that in normal stars it is slightly less probable than the reaction between protons and carbon or nitrogen. However, since it involves a relatively small potential barrier, this reaction will fall off less rapidly than others when the temperature is decreased. It is, therefore, presumably the most likely reaction around 1,000,000°. But even at 20,000,000°, its rate would only be sufficient to consume all hydrogen in a star during the course of several billions of years, which is removed from an explosive reaction by at least a factor of 10^{17}. At 1,000,000°, the reaction must be considerably slower than this.

THE FISSION OF WATER AND AIR

Many scientists have asked me in recent letters why it is possible for the stars to have a sustained nuclear reaction if it is not possible for the water or the air to become ignited by an atomic bomb. The difference between the two situations is that in the sun the temperature is kept high because it is difficult for the sun's radiation to escape. The temperature in the sun changes very gradually from the 20,000,000° in the center, to the 6,000° at the surface. There is nowhere a strong temperature gradient and therefore the transport of radiation is very slow. If we explode an atomic bomb under water, and even if we were to succeed in heating the water to the same temperature as the center of the sun, this high temperature would only be attained in a very small volume. Radiation would carry the energy away very rapidly to the surrounding water. This means that in order to get a self-sustaining reaction one of two things must be done: First, the energy developed by the nuclear reaction must be so great that it overcompensates the loss of heat due to radiation. Even the most probable nuclear reactions discussed above fail to do this by a factor of at least 10^{26} at 20,000,000°, and by a much greater factor at 1,000,000°. The second possibility is to heat a very large volume of water simultaneously to a very high temperature, but this clearly requires enormous amounts of active material in the atomic bomb, exceeding by many powers of 10 the sizes of bombs ever contemplated.

The examination of possible nuclear reactions has to take into account also other possibilities, involving rarer elements, such as the reaction between two deuterium nuclei. This reaction is the most probable known nuclear reaction at low temperatures. However, even pure deuterium would fall far short of sustaining a chain reaction at 20,000,000°, and the very small amount of deuterium in water will be of no consequence whatever in this connection.

ACCURACY OF THE CONCLUSIONS

It is often argued that considerations of the type here given involve a considerable extrapolation of present knowledge. It is my personal opinion that this is not the case. The energies of the nuclear particles involved are very small—below the energies normally used in the laboratory. While we should be very cautious in extrapolating our present knowledge of nuclear physics to higher energies, where new phenomena will certainly come in, we have very good means of extrapolating to lower energies. Such an extrapolation involves only the use of standard quantum mechanics as embodied in the Gamow theory. This theory has always been confirmed by experimental investigations of the cross sections of reactions

(Continued on page 14)

The Moral Responsibilities Of Scientists . . . . *A. V. Hill*

THE ETHICAL BASIS OF MEDICINE

The problem we are to discuss today is very far from being a new one: indeed 'The responsibilities of scientists in modern society' are as old as science and society themselves. Seventeen hundred years ago there crystallised out, from many centuries of discussion and experience of the moral basis and the ethical necessities of medicine, the so-called Hippocratic Oath.

'I will look upon him who shall have taught me this art even as one of my parents. I will share my substance with him, and I will supply his necessities, if he be in need . . . The regimen I adopt shall be for the benefit of my patients according to my ability and judgment, and not for their hurt or for any wrong. I will give no deadly drugs to any, though it be asked of me, nor will I counsel such . . . Whatsoever house I enter, there will I go for the benefit of the sick, refraining from all wrong doing or corruption, and especially from any act of seduction . . . Whatsoever things I see or hear concerning the life of men, in my attendance on the sick or even apart therefrom which ought not to be noised abroad I will keep silence thereon, counting such things to be as sacred secrets. Pure and holy will I keep my life and my art'.

Without an ethical basis to medicine civilization itself as we know it might be pretty well impossible. The influence and extent today of the national and international agencies described under the title of the Red Cross show how potent still, in spite of totalitarian war, is that moral background. Medicine was the first and remains the most difficult of all the natural sciences, the mother of many of them; and it is surely of extreme significance that tradition has attached to the same name the Hippocratic Oath and the Hippocratic Method—the ethical injunction on the one hand, the scientific claim to decide by observation and experience on the other. Medicine has been built up on a joint tradition of scientific method and moral value incarnated and hallowed in a single human personality.

MORAL STANDARDS IN SCIENCE

The other sciences lag many centuries behind medicine in the ethical approach of their practitioners to their job: the ultimate purpose of our discussion today is to see if anything can be done about it. There was a time when science and learning were accepted as a natural bond between nations often otherwise not on speaking terms: they might still be so if scientists in all countries would, or could, insist on maintaining a common ethical standard for their calling. Failing that, one can foresee the time when scientific discovery and invention may provide instead one of the chief stumbling blocks to international co-operation and the chief means for mutual destruction. If standards of truthfulness, frankness and integrity are relaxed, either for political motives or for private ambition and gain: if fraud, dishonesty and self-deception are not denounced, if mistakes are not honestly acknowledged and corrected, if propaganda is accepted in place of fact: if the common prestige and good-will of science are prostituted for base, sectional or selfish purposes: if secrecy or secretiveness is accepted as a normal condition of scientific work: if age, prestige or authority, if race or nationality, is allowed to hinder freedom of intercourse, or equality and interchange of ideas, between scientists of honesty and good will anywhere in the world: if there is widespread failure to recognize an unbreakable obligation—as it should be—that the benefits of scientific discovery must be regarded as a sacred trust for mankind: then, science itself may become impossible as a calling for free and honest men, while its exploitation for sectional gain, or national aggrandizement, may lead to conflict and destruction instead of co-operation and welfare.

THE ETHICAL PROBLEM TODAY

It took hundreds of years for a common standard of medical ethics to emerge: we can scarcely expect a common standard of scientific ethics to appear ready-made. All kinds of difficulties will be evident, partly from political barriers and lack of freedom, partly from scientists themselves who are—many of them—pretty peculiar creatures to steer in a common direction, not least from the big bosses who look upon science as a purchasable commodity and scientists as back-room-boys to be kept in their proper place. But the matter is urgent and these are critical times, and a clear and unambiguous statement of the problem may help—as it helps any scientific problem—towards its solution. There is no suggestion—at least I make none—that scientific men as such need feel an obligation to spend their time directly in political, social or economic affairs: they have their own expert contribution to make to public and international welfare, and their experience in natural science gives them no special qualification for politics, sociology or economics. Indeed a dislike of misrepresentation and of compromise with the truth makes them usually pretty inefficient politicians. Like other citizens they have their political rights and social duties: they exercise them not as scientists but as citizens. As scientists, however, they have the right, and duty, to question and discuss the nature of their own calling and its special contribution to national and international welfare. They should feel an honorable and unbreakable obligation to keep the scientific faith of frankness, honesty and integrity: to avoid secrecy and secretiveness as necessary conditions of their work: to treat all honest scientific men anywhere as their co-workers in a common cause: not to exploit the common property of science for base or selfish ends: and to refuse conditions of employment or advancement, however otherwise attractive, which do not meet the ethical requirements of one of the most important common interests of mankind. I would add one further duty, to refuse to co-operate in tasks in which they, or their representatives, are not allowed a reasonable share or partnership in the responsibility of deciding on the purpose, policy or probable result of their work.

CONCLUSION

To a cynical observer of the recent behavior of *homo sapiens* these moral reflections may seem naive: and I admit I often feel sceptical myself about the outcome. But I see no alternative: we scientists throughout the world must take the initiative in these matters and not leave it to others who may wish to use us as their tools—otherwise we and civilization will perish together. The world at present is infected with partisanship, mistrust, political conjuring and the witchcraft of words and phrases: the common lot of mankind will not be raised by such devices of expediency: a common motive of principle, morality and co-operation is required. That motive, if we scientists have faith in our method and ideals, we can help to provide. No grandiose plan for conducting an international scientific orchestra is wanted: that would certainly play out of tune and out of time—if it played at all! We must build patiently on existing foundations—or, as a better metaphor, we must tend and care for the living organism of friendly international relations in science which already exists. The need is not for working drawings of new machinery: living organisms do not grow to maturity that way. What is needed rather is the inspiration of a great ideal, a common interest, a common standard of ethical behavior, a common refusal to sacrifice or exploit a universal good for a temporary or sectional advantage. How we can

(Continued on page 15)

How Germany Lost The Race . . . . . S. A. Goudsmit

I was connected with the War Department mission which was sent overseas to investigate the progress made by the Germans on the atomic bomb. My conclusions are based on having had access to all German material and on having contacted all key men on this project in Germany.

The German line of thought was as follows:

1. An energy-producing uranium engine is more likely to succeed than a bomb. In fact, they had entirely abandoned the hope of making a bomb during this war.
2. An atomic bomb is an uranium engine which gets out of control; therefore, the road towards a bomb leads via the construction of the uranium engine.
3. To make a bomb of pure plutonium never entered their minds, or at least was not considered feasible and not taken seriously. The idea of using a pile to produce plutonium and to make a bomb out of that material came to them only slowly, after the detailed radio descriptions of our bomb in August 1945.
4. An uranium engine is just as important as a bomb because it will make Germany economically self-supporting by the enormous power it may produce.

As a result they concentrated their efforts on the production of atomic energy, and all the work done was nothing else but trying to build what is called over here a pile, an uranium machine.

The Germans worked hard on the pile; at the end of the war they had merely come to the conclusion that a heavy water pile was possible. They never did construct a self-sustaining pile. They had not produced a chain reaction. The war ended too soon, and they probably would not have had enough heavy water for a working pile. They were also not aware, of course, of numerous new difficulties they would have encountered if they really had progressed with their attempt at building a pile.

The remarkable thing about the Germans is that throughout the war they believed that they were ahead of our effort along those lines. Not until the news broke that the atomic bomb had been dropped did they realize that they were not ahead, but that they were behind.

REASONS FOR GERMAN FAILURE

The reason for the lack of progress in Germany, as I see it, can be put down in a number of points.

The German scientists seem to have lacked the vision. They did not believe in success from the very beginning. They were convinced that the project was important; but they did not believe that it could be done within a reasonable time.

Another reason why the Germans did not make any real progress was that the key men in administrative positions were utterly incompetent. For instance, Army Ordnance had as its chief adviser on military matters a second-rate physicist named Schumann, and the scientists he had working with him were definitely inferior compared with the scientists who were available in Germany for such a project. Several other groups worked independently under different sponsorship—including the Air Ministry and the Ministry of Post and Telegraph.

It is clearly understandable that in such a way they could not go very far. It was only later, after the war went badly, that the thing was better coordinated and that one man was put at the head of the whole organization, a competent scientist. That was around 1943.

They were seriously handicapped by the lack of prestige which science has in Germany. When the war broke out, all German scientists were drafted. One of the top scientists was a corporal for a while, and stated that his Army experience was like the usual mountaineering, only made difficult by the presence of sergeants.

Pretty soon the key scientists were taken out of the Army and put back in the laboratories; but the bulk of the German scientists remained in the Army for several years, 2 to 3 years. Several were killed in action as soldiers.

Only when the war went bad, especially after the U-boat war went bad, were scientists released from the armed forces and put back on war work, which on the whole was not very successful, except for the Air Force.

Prior to the war, one of the key German scientists went around the country lecturing for various officials of the Air Forces, to point out that Germany was rapidly declining in the fundamental sciences.

He attributed it primarily to lack of support for science, to some extent to the loss of scientists because of persecution, and to a greater extent to the replacement of those scientists by incompetent party members instead of good scientists.

HISTORY OF GERMAN ATOM BOMB RESEARCH

Early in 1939, as was done in England, France and America, several German physicists called to the attention of the military and of other authorities the possibility of making a superexplosive as a result of the discovery of uranium fission. A group of physicists met and formed the Uranium Society (Uran Verein). This was originally an informal group, exchanging information among each other, but keeping such information from outsiders.

German nuclear physicists proceeded with their research independently. Army Ordnance had a scientific group under a second-rate physicist, Schumann, which started work on this problem.

He went to France and tried to get the French development out of the hands of the French, and to move the French cyclotron. Later, he decided not to move it but to make it work, and sent some Germans down to put it in order and operate it.

He had a small project going on in one of the Army proving grounds near Berlin.

The best-qualified groups were the Kaiser-Wilhelm Institute for Physics in Berlin, under Heisenberg, and the physics section of the KWI for Medical Research in Heidelberg, under Bothe. Bothe, as well as Heisenberg, made a survey trip through the United States of America in the Summer of 1939.

At the beginning of the war, each academic research group had to find its own sponsor. The German Air Forces had the best and most liberal set-up for research, and some nuclear physicists were fortunate enough to get support from them. A private scientist, Baron von Ardenne, a clever technician and businessman, got the Minister of Post and Telegraph, Ohnesorge, interested in his research. Ohnesorg was near to Hitler and kept the Fuehrer informed about the importance of the project. For awhile, von Ardenne was considered by the German authorities to be the expert on the uranium problem, much to the dismay of the really competent scientists.

The various groups worked in competition with each other. The sabotage and bombing of the Norwegian heavy water plant had cut their supply so that it was barely enough for one group to make important experiments. As a result, disagreements arose concerning its use.

The bulk of German scientific research was under the Ministry of Education (Minister Rust). It was governed by a Research Council under an incompetent administrator and second-rate chemist named Rudolph Mentzel, a brigadier in Himmler's SS.

Early in 1942 the members of the Uranium Society thought it necessary to call the project to the attention of the highest members of Government and military organizations. A special secret meeting was called by Minister Rust and General Leeb, Chief of Army Ordnance, to which all top-ranking officials were invited. However, most of them declined or sent

(Continued on next page)

The German Atomic Energy Project . . . . . Continued

(Continued from page 4)

minor representatives. It is doubtful whether this meeting had any success.

A few months later, the Research Council was taken out of the Ministry of Education and, by Hitler's decree, placed under Goering. It was hoped that this change would bring research on other subjects up to the same high level as that of the air forces, but matters did not turn out that way. The incompetent Professor Mentzel remained the active head of the Research Council.

Professor Esau was put in charge of uranium research. Later, some time in 1943, he was replaced by the physicist Walther Gerlach, of the University of Munich, a really first-class experimental scientist and organizer. At the same time, Army Ordnance seems to have gotten tired of this apparently hopeless research and turned the facilities and men over to the Research Council. Upon Gerlach's shoulders fell the difficult task of reconciling the two principal groups working on uranium—the Kaiser-Wilhelm Institutes and the former Ordnance Group.

In the meantime, Allied bombing had forced the scientists to evacuate their well-equipped laboratories in the cities and to seek shelter in rather primitive quarters in various small villages spread all over Germany.

In studying the Research Reports, one is, first of all, impressed with the slowness of the progress. At the beginning of 1945, most of the research was still in practically the same state as it had been in 1943. Isotope separation had been tried only on a very small scale, by means of a centrifuge. It had been found that the Clusius method did not work. Research on several other methods had been dragging on for a few years without much progress.

Some of the key scientists worked only part time on this important research and the rest of the time did routine teaching or administrative work. The lack of proper large-scale facilities necessary for this kind of work was, of course, another reason for the lack of success.

Attempts were made to have German chemical industry produce heavy water because the Norwegian plant had been destroyed. However, not much progress was made with this plan either. Uranium metal was produced in quantities sufficient for small-scale experiments, and the stock of heavy water seemed to be just enough for that.

The effort was small, though it had the highest priority among all scientific research projects in Germany. The total expenditure was about 15,000,000 marks, which is perhaps equivalent to some $10,000,000. The appropriation for 1944-45 was 3¼ million marks with a subsequent supplement of 1,000,000.

It is estimated that approximately 100 scientists were active on this project. They were divided into several rather small groups working on different phases of the problem, and were spread all over Germany.

SECRECY IN THE GERMAN PROJECT

Almost nothing was known here about the German project before the invasion of continental Europe, in spite of the fact that the German security provisions were not of a very high standard. Letterheads and envelopes were used which clearly indicated the prominence given to nuclear physics, reading "The Marshal of the German Reich, President of the State Research Council, Plenipotentiary for Nuclear Physics," or "The Plenipotentiary of the Reichsmarshal for Nuclear Physics," which gave Gerlach the nickname of "Reichsmarshal for Nuclear Physics." In draft deferment requests, the reason was clearly stated as "Working on Energy Production from Uranium." There were some weak protests against this lack of security, but to no avail. However, this stationery was never used for correspondence with neutral countries. The locations to which the laboratories had been evacuated were kept very secret.

German scientists knew practically nothing about Allied developments, aside from what they picked up in the summer of 1939. They received some utterly wrong and useless information from the German intelligence, information obtained from travelers or other unreliable sources. There was a rumor in 1943 that the German intelligence had information about atomic bomb-work being performed in the United States. This apparently was not taken seriously, as further details were lacking.

PROJECT RESULTS AND POLITICAL POLICY

Toward the end of the war, the German experiments had indicated that it was possible to obtain an increase in the number of neutrons, but no self-sustaining neutron source had been constructed as yet. The German scientists considered this achievement of great importance. They were convinced that they were far ahead of the Allies. They believed that this success might play an important role in the settlement of the peace terms, for they understood correctly the immense implications of the uranium-energy project. Even if the peace terms might not be influenced by them, they hoped that this achievement would at least insure for German science a leading role in the world and save Germany in that way. These thoughts were, indeed, the driving force behind the German scientific efforts. Gerlach was greatly excited when he learned about the favorable result of the preliminary experiment. He immediately informed Bormann, the head of the Nazi Party, reassuring him of German supremacy in this field. Gerlach was quite upset when, shortly afterward, the S.S. spread rumors that the Germans were soon going to use a uranium bomb. The scientists knew that they were still far away from that goal.

Himmler's S.S. had begun to take an active interest in research and especially in the uranium project. This organization had threatened to evacuate key scientists and their equipment to the Bavarian redoubt where they would be forced to complete the work under pressure. To the relief of the frightened German scientists, this plan failed, probably because of the rapidity of the German collapse. Only one group was actually kidnaped by the S.S. and let loose in Bavaria.

CONTROL PROBLEM

In my opinion, a survey of the German work on uranium energy leads to certain recommendations for eventual control of uranium research.

It has become evident that such supervision can only be had with the help of qualified scientists. The present military methods of intelligence or of occupation are totally inadequate for the control of scientific research. These merely lead to such utterly useless extremes as the destruction of the cyclotrons in Japan.

As soon as our mission got in touch with the first physicists, the first physics laboratory, the first correspondence and documents on physics which were available on the Continent, we obtained the complete story. If there could be free interchange of ideas among the scientists, if they could travel freely, if they were allowed to visit each other's laboratories, if that were possible, then as long as scientists are working or have to be used in work on an atomic bomb or anything of that nature, I don't believe that it can be kept secret.

The scientific cooperation which exists among scientists all over the world overcomes the barriers of war and differences of political opinion. I feel certain that, if all countries grant complete scientific freedom to their research workers—the scientists' free choice of research problems and freedom of publication — no dangerous activity will, or can, be kept secret as long as scientists are involved.

An Appeal To Reason . . . . . E. U. Condon

The last war's destruction far exceeds that of any catastrophe yet known. The war ended with the application of a new weapon that is a thousand times more frightful than the weapons which produced most of the war's frightfulness. And already we have responsible statements from scientists who made this development, that bombs a thousand times more powerful than those already used are capable of being made in the near future. There are men living who know how to make a single bomb whose destructiveness is equal to a million ten-ton blockbusters. One such bomb, dropped on Washington or any other major city, may be expected to wipe out its population, to destroy its buildings utterly, and to render the site uninhabitable due to poisoning by radio-active materials.

THE CHOICE OF ATTITUDES

In the face of this situation, people react essentially in one of two ways. The first kind say: "It's just another weapon. Mankind learned to adapt itself to the long bow, and the cross bow, and the B29. We have always had wars." An extreme expression of this kind of pessimism is found in a speech by Prof. Leslie A. White of the anthropology department of the University of Michigan. He says, "As for the extermination of the human race as a consequence of hurling atomic thunderbolts, this too may be admitted as a possibility, and all we can say is that if it is to come it will come. Extravagant expressions of horror will not alter the course of events."

In our language, "extravagant" connotes exaggerately inaccurate and thus detracts from the serious warnings which responsible physicists are trying to give us. Now I would agree that expressions of horror alone will not alter the course of events. But I insist that if we look at what civilization has suffered in World War II, even before the atom bomb, and couple it with the picture of a war with plentiful use of "old-fashioned" atom bombs, and further with the picture of a war with both sides equipped with the really potent 1950 models — then, I say, no expression of horror of which our hearts are capable can be exaggerated or extravagant. I say we need not and should not fatalistically await death, while reading papers to an academic society in Philadelphia.

The second kind of people react differently. They say, this is the end of the road. Mankind has brought down suffering and death on its head, spiritual values have been destroyed, hatreds have been nourished and developed into great social cancers by war, and the war fears, and the war suspicions and divisions among men. This has been going on since the beginning of time and will surely destroy us all if we let it continue. We say simply that this must stop. We read the lesson of history to be that men can go forward together, and that men can progress to new freedoms, and new areas of social adjustment. The magnitude of the present crisis is such that we must soberly think of the choice as being between drifting into a war which will lead to the destruction of civilization, leaving a remnant of stunned, confused, poverty-stricken, frightened men and women amid the ruins,—or a wholesome healthy development of a united mankind, using its intelligence cooperatively for the good of all.

I beg of you, cast in your lot with the persons of the second kind—the people who believe there is a possibility that men throughout the world can live in freedom and justice, in love and good-will, that they can devote their full energies to constructive application of the rational thinking we call science to the arts of peace. In asking you to join with us, I make no promise of certain security. I only promise hope, and tell you that the other way leads to certain doom. If we try to establish the brotherhood of man on earth we may fail, but if we do not even try we shall surely fail, and what an unbearable load of guilt our consciences will then have to carry.

We must assert ourselves in every kind of agency of world cooperation toward positive wholesome working together for human welfare. This means specifically support to UNO, UNRA, and UNESCO and whatever other such activities lie ahead.

We must particularly seek to bring about closer working relationships with the Russians. Russia and the United States are today the most powerful nations in the world so unless we can get along together, there is no hope for peace.

SCIENTIFIC AND MILITARY PROCEDURES

We must regain for all scientists that freedom from military domination which is so necessary if science is to be used for peaceful ends. With militarism not wholly exterminated in the world, we must have scientists contributing to the development of our tools of war, since, God forbid, we may, if all else fails, have to use them. But the scientific life of the country must not be subordinated to, nor derive its chief support from, the military.

This is essential in the interests of the military themselves. Because the scientific spirit is so completely opposite to the military spirit, science simply will not go forward under military domination. Nowadays men must work together in large organizations. It is characteristic of the military organization that operations are planned and directed from the top, with the details executed by men below, by persons who unquestioningly and obediently respond to the orders given them from above. The flow of original thinking is from the top to the bottom. I conceive just the opposite to be true in a properly administered scientific organization. The function of a scientific director is to set up working conditions where the lowliest novitiate is put in touch with all the problems in his field and encouraged to worry about them and to come out creatively with new ideas and results. He is the sole judge of what knowledge he needs in order to work effectively on his problem. The flow of original thinking in this case is mainly from the bottom to the top.

Every worker must have access to the whole story because no one can foresee which scientist will have the truly creative idea. And each scientist must be free to discuss his ideas, while in the formative state, with his colleagues anywhere, for it is from the working together of many minds that new science comes.

In contrasting the military and scientific, I do not wish to imply that one is wholly wrong and the other wholly right. Just as I do not recommend the military procedure for the conduct of scientific research, neither would I want our safety to depend on the outcome of a battle in which the scientific method of free discussion, independent thinking and mutual criticism was followed by all the captains and lieutenants on the battlefield. Military operations and scientific research are two quite different kinds of human activity and neither should be subordinated to the other.

THE DOMINATION OF SCIENCE BY THE MILITARY

Of course my reason for stressing this point is that right now we are confronted in America with a situation in which scientists are being held very strictly under military domination, to the severe detriment of our scientific development and the development of wholesome international relations.

What is going on? Prominent scientists are denied the privilege of traveling abroad. Physicists are not allowed to discuss certain areas of their science with each other, even as between individuals working on closely related phases of the same subject. They can only communicate through official channels, involving censorship of their communications by army officers without knowledge and so without competence. Information essential to understanding is being denied to students

(Continued on page 7)

E. U. Condon—Cont.

in our universities, so that, if this situation were to continue, young students will get from their professors only a watered-down army-approved version of the laws of nature.

In this connection one is reminded of the Holy Scriptures where in the 18th verse of the 8th chapter of Ecclesiastes we read,

"Wisdom is better than weapons of war; but one sinner destroyeth much good."

The laws of nature, some seem to think, are ours exclusively, and that we can keep others from learning by locking up what we have learned in the laboratory and not telling it to our allies. Later they will learn what we know and more besides, which because of our unfriendly behavior, we cannot expect them to tell us.

It is sinister indeed how one evil step leads to another. Having created an air of suspicion and mistrust, there will be persons among us who think other nations can know nothing except what is learned by espionage. So, when other countries make atom bombs, these persons will cry "treason" at our scientists, for they will find it inconceivable that another country could make a bomb in any other way except by aid from Americans.

Let us cast this isolationist, chauvinist poison from our minds before we corrode our hearts and arouse suspicions of our motives in the minds of the decent peoples of the world. Let us cooperate wholeheartedly with the other nations of the world to agree to use atomic energy only for peaceful purposes and to set up an inspection system to enforce such agreement. The United Nations Assembly has uanimously voted to establish an Atomic Energy Commission to draw up such a plan. In the face of the frightfulness of atomic warfare, it is inconceivable to me that any nation will refuse to participate in a program of international cooperation and inspection. Yet, much public discussion, and even more private conversation, is based upon the assumption of such a refusal. We must push forward with all possible speed in order to find out where we stand in the world today so that it is no longer possible for different groups and different nations to base their thinking and their planning upon different hypotheses. I am confident that if we do this the outcome will be world friendship and cooperation, and not atomic war and the destruction of civilization.

In closing I would like again to quote Scripture, this time the New Testament, 17th verse of the 8th chapter of Luke:

"For nothing is secret, that shall not be made manifest, neither anything hid, that shall not be made known and come abroad."

THE CANADIAN ATOMIC ENERGY PROJECT

The "spy scare" has atracted attention to the part played by Canada in the research which led to the development of the atomic bomb. The following is a brief outline of the Canadian project.

* * *

Before the fall of France, French scientists working on the problem of atomic fission were sent by Professor Joliot to join the British scientists. Towards the end of 1942, the British proposed that an important section of the work should be carried on in Canada as a joint enterprise.

The primary material required for the production of materials for atomic bombs is **uranium.** One of the world's two most important deposits of this substance was discovered by Gilbert LaBine near Great Bear Lake in Canada. To preserve this important asset for the people of Canada and to protect the supply for the United Nations, the Dominion Government took over the ownership of the mines and the extraction plant.

A pile has been built in the Chalk River township situated on the south bank of the Ottawa river near Petawawa on a 10,000 acre site appropriated for the purpose. It will also produce large quantities of radio-active materials for application in medicine and research, and will provide a powerful source of neutron rays for research on atomic physics.

The construction of the plant followed an agreement in April, 1944 of the Combinde Policy Committee representing the United Kingdom, the United States and Canada. This Committee, under the chairmanship of Mr. Stimson, United States Secretary of War, and with Canada represented by Mr. Howe, was created as a result of a discussion between the partner governments at the Quebec Conference in 1943, to bring research work directed towards the atomic bomb in Great Britain and Canada into the closest co-operation with the tremendous undertaking in the United States. The Commitee agreed that a **pilot plant** for the production of plutonium, a pile containing uranium metal and heavy water should be constructed in Canada, while the United States should concentrate on two other methods of producing fissile material, the production of plutonium in the uranium-graphite pile, and the separation of U235 from natural uranium.

The fundamental design of the plant has been the work of the Montreal Laboratory of the National Research Council. This laboratory was set up in Canada in 1942 for uranium research and staffed by a combined group of scientists from the United Kingdom and Canada, and included some from France assigned by the Free French authorities to collaborate with the British scientists. The Laboratory is administered by the National Research Council under its president, Dr. C. J. Mackenzie, and directed by Prof. J. D. Cockroft, Jacksonian Professor of Natural Philosophy, Cambridge University, England, with Dr. E. W. R. Steacie of Ottawa as Deputy Director. Its staff has now grown to over 400 and it has been described as the largest organization ever created in Canada to carry out a single research program.

The erection and operation of the pile have been entrusted by the Department of Munitions and Supply to the crown company, Defence Industries Limited. Broad policy in design and operating procedure is decided on behalf of the Government by a Committee of Management under the chairmanship of H. Greville Smith, Vice-President and General Manager of Defence Industries Limited, which includes A. B. McEwen, M.E.I.C., Manager of Special Projects of Defence Industries Limited and H. J. Desbarats, Works Manager of Petawawa plant. The National Research Council is represented on the committee by Dr. Mackenzie, Dr. Cockroft, Dr. Steacie and R. E. Newell, Head of the Division of Engineering in the Montreal Laboratory. The Department of Munitions and Supply is represented by A. N. Budden, M.E.I.C.

* * *

Since the American methods for the chemical separation of plutonium have not been shared with the Canadians and British, it must be assumed that the latter have developed their own processes. In fact, it has been asserted (Senate Committee Hearings on Atomic Energy, part 2, p. 281) that their method is superior to that employed at Hanford, but we are not certain about it since secrecy works both ways.

LONDON CONFERENCE

A conference on the general subject "Science and Welfare of Mankind" was held in London, England on February 15-17, under the auspices of the British Association of Scientific Workers. Representatives from many European, South American, and Asiatic countries attended. Dr. John Simpson, Chairman of the Executive Committee of the ASC was present at the meeting, as observer for the Carnegie Endowment for International Peace.

We will present a more detailed report on the London meeting in our next issue.

The Atomic Bomb and International Organization

. . . . . James T. Shotwell

In all the history of politics there is nothing comparable to the revolutionary effect of the atomic bomb. Its announcement by President Truman last August was a solemn warning, even in the heart of the war, that the weapon which scientists and engineers had created might destroy not only civilization but the earth itself unless it could be brought under effective and responsible political control.

Yet no political body existed, or ever has existed, capable of exercising the control necessary to meet so great a danger.

The first and most natural impulse was to demand, immediately, a world government capable to provide a universal guarantee of safety against universal danger. It is significant that this movement for world government was strongest in those very nations whose political structure is based upon the English tradition of representative self-government. Paradoxically, this demand that national sovereignty be surrendered to world governoment was based upon a theory almost wholly contrary to that upon which representative self-government is founded. World government seems to have been conceived as a device for safety; and safety under the conditions of modern warfare calls for quick executive decisions and immediate exercise of power because of the deadly timetable which has to be met in the hour of crisis.

What is needed is an international system for peace and security which, while providing against the danger of scientific warfare will enhance, rather than lessen, the growth of domestic freedom. That, then, is the modern political problem created by the scientific revolution of today.

Clearly it is not a problem which can be solved by concentrating all attention upon the conquest of the atom, or even upon all the other major achievements of modern science. For political problems cannot be solved by ignoring the nature of politics or the history of the national state.

NATIONAL STATES—AND WAR

The nation which pioneered in developing the national state was England, and the time was the seventeenth century. The British Parliament took over the prerogatives of kingship and the liberties of citizens were guaranteed in an epoch-making Bill of Rights.

It was to preserve liberties thus won that, almost a century later, English colonists in America declared their independence and set up safeguards of individual freedom in a Constitution and a Bill of Rights.

On its heels had come the French Revolution with its Declaration of the Rights of Man and the Citizen. When, in sequence, other European peoples, throwing off their despotic governments, established new systems, most of them followed the English model. However, the prevalence of wars there gave to the military class an importance denied them in the British Isles. This trend toward autocracy was checked throughout the nineteenth century by liberal movements, but finally culminated in the Fascist-Nazi philosophy.

From this outline of a vast range of history it is evident that war or the threat of it is the chief enemy of freedom, not only to conquered peoples but to their conquerors as well.

Throughout all the past there have been protests against the horrors of war, and idealists have ventured to draw plans for permanent peace. Yet these efforts had little or no practical effect upon the policies of nations prior to the twentieth century. In 1914, war was still the admitted arbiter of the fate of nations.

ATTEMPTS AT GENEVA AND WASHINGTON

In 1919, the Covenant of the League of Nations took a step forward when, in Article I, it declared that "war or the threat of it anywhere in the world was a matter of concern to all members" and that the Council should take such measures as it deemed necessary to preserve the peace of nations.

This was as far as the world was willing to go at the end of World War I; and as history proved, was even more of an obligation to preserve the peace than most of the nations were willing to accept. The U.S.A., itself, kept out of the League—weakening the fabric of world solidarity.

Then the movement toward disarmament was taken up at the Washington naval disarmament conference in 1921. Continental European countries refused to accept the American lead. They insisted that nations could only disarm in proportion as they were granted security by other means. Their reasoning was sound, as we would have recognized had our frontier on the East been the width of the Rhine instead of the Atlantic Ocean. Nor did the League of Nations itself offer them a full guarantee of peace. Consequently the Europeans set about implementing the League Covenant. In 1924, the Assembly passed what was known as the Protocol of Geneva, an amending treaty to be accepted by all League members. In this, war was at last declared to be an international crime and the nations bound themselves together to protect each other in case any nation went to war against any other.

Had this Protocol of Geneva been adopted, the Second World War could not have happened as it did. Unfortunately, the conservative government which their came to power refused to ratify the Protocol—insisting that it must be its own judge as to whether the accused nation was really an agressor or not. Thus a great fabric of European solidarity to preserve the peace broke down—this time by the refusal of the British to accept the political judgment of the League.

The outstanding conclusion from the experience gained between 1921 and the outbreak of the second World War is that there will be no way of checking the race in atomic weapons in future years unless at the same time we set about the elimination of war itself; and that the outstanding example of how his can best be done is the unratified Protocol of Geneva.

THE UNO CHARTER

This is the history which lay behind the making of the Charter of the United Nations, framed at San Francisco. The Charter contains the obligation that "all members shall settle their international disputes by peaceful means in such a manner that international peace and security and justice are not endangered." Unfortunately this commitment is in what might be regarded as a preamble; and although Chapter 6 provides an iron-clad system for settling disputes peacefully, the veto of the Great Powers might conceivably be used by any one of them to escape the final jurisdiction of the Security Council itself.

The situation therefore, at the present time, is that the Charter needs to be buttressed by additional treaties, one to implement its control of armaments and the other to provide a realistic, binding covenant against war itself.

With reference to the international control of atomic weapons, a good case could be made for placing the control in the hands of the Assembly rather than of the Security Council, because the Assembly is, in theory, the supreme body. According to Article 11 of the Charter, "it may discuss any questions or matters within the scope of the Charter" and, under Article 11, "may consider the general principles of cooperation in the maintenance of international peace and security including the principles governing disarmament and may make recommendations with regard to such principles to the Members, or to the Security Council, or to both."

(Continued on next page)

The Atomic Bomb and International Organization

. . . . . Continued

(Continued from previous page)

The Security Council, on the other hand, is an emergency body primarily concerned with the settlement of disputes. However, it is also responsible (Article 26 of the Charter) "for formulating with the assistance of the Military Staff Committee... plans to be submitted to the members of the United Nations for the establishment of a system for the regulation of armaments." Under this provision the Security Council thus has a more definite mandate than the Assembly to deal with armaments.

The Assembly recognized this fact when it set up a Commission for the Control of Atomic Energy—for it made the membership of that commission identical with the membership of the Security Council with but one exception, that of Canada. It also directed the Commission to submit its reports and recommendations to the Security Council.

Furthermore, in order to leave no possibility of doubt as to the place of this Control Commission in the UNO, the resolution of the Assembly stated that "in view of the Security Council's primary responsibility...for the maintenance of international peace and security, the Security Council shall issue directions to the Commission in matters affecting security." Only in matters not affecting these grave questions of war and peace would the Security Council be called upon to transmit reports of the Commission to the Assembly or to the Economic and Social Council.

In short, the Council retains final control with reference to recommendations "for the elimination from national armaments of atomic weapons and of all other major weapons adaptable to mass destruction" and for the erection of "effective safeguards by way of inspection and other means to protect complying States against the hazards of violence and evasions."

TRIPARTITE ADVISORY BODY

If the Security Council needs a **military staff committee** to advise it on armanents of the pre-atomic age, surely it will require the services of a **technical body** to analyze the problems and to prepare plans for the control of atomic energy. Only highly competent specialists can say whether the safeguards which have been proposed are adequate or not.

On the other hand, it would not be wise to leave the whole problem entirely in the hands of scientists. There should be, alongside the scientists, men who are experienced in the conduct of public affairs and especially in the working of international organizations. And along with both, the military experts—not to dominate discussions but to prevent the conclusions from losing sight of their main objective.

I suggest, then, that a tripartite body of this nature is necessary for the effective carrying out of the purposes of the commission on atomic energy. Its power, however, should be limited to recommendations to the Security Council. A technical body, no matter how highly qualified by knowledge and experience, should not have the final decision—even in matters that lie so largely within its field as that of atomic energy. But such recommendations by a body as competent as this could not be readily passed over by the Security Council.

INTERNATIONAL INSPECTION

Preliminary studies have already shown that it is impossible to devise a system of inspection which would be a perfect safeguard against surreptitious violation.

Scientifically, therefore, one can say inspection will break down, for it can never be absolutely complete. Politically, however, it may be adequate—and this is a point of supreme importance—if it can be developed to the point of indicating where a nation or an enterprise within a nation seems to be engaged upon suspicious activities or becomes unduly secretive concerning its activities. Now there is reason to hope the technique of international inspection can be carried this far with enough guarantee against evasion to permit nations to proceed with their peaceful activities, unhampered by the haunting fear of secret preparations for atomic war against them.

The establishment of international inspection may therefore be something more than a first step towards international control. Even if no other steps were taken looking to the enforcement of peace, an agreement not to keep armanent preparations secret might eliminate from international relations the poison of suspicion, which is one of the deadliest of all poisons in human affairs. But this first step implies the second one of international supervision of control. There must be force behind the agreements, and that force must be adequate to rid the world of any threatened illegal use of "atomic energy and other major weapons of mass destruction." It is wrong, however, to deal with this problem wholly in terms of police power. The principle upon which the new world order must be based, the only principle upon which peace will be secured, is that of the common interest of all nations in the elimination of the greatest danger of all times. It is not enough merely to get rid of armaments. The atomic bomb has at last made clear the imperative need of getting rid of war itself.

THE PREVENTION OF WAR

Following the model of the Geneva Protocol, the prohibition of aggressive war must be made real and to make it real it must not only have force behind it but it must rest upon a definition of aggression which, if applied, will curtail the application of the veto power, and insure rapid and effective action against an aggressor. The definition needs to be reconsidered in the light of atomic warfare, but the fundamental principle of the Protocol remains: namely, that any nation is an aggressor which turns from the peaceful means which it has already accepted for settling disputes and prepares for war instead.

In applying this definition, the first question that arises is at what point in a situation which looks like a threat of war the international organization should step in, and how. This is the point at which most plans for world peace have broken down. But now the way lies open for its solution, if the provision for inspection of atomic weapons becomes an established routine and is not in the hands of militarists. **The detection of any conspiracy against the peace by a commission largely made up of technical experts would be more devoid of political prejudice and more objective in fact-finding than any purely political arrangement of governments.**

Thus the problem of inspection could be made to work directly toward the prevention of aggressive war. I have not the slightest idea whether this suggestion will be deemed practical by those responsible for our policy but I am of the opinion that it is the best way open to us now to achieve results which are absolutely essential if civilization is to endure.

In line with this conclusion, I may revert to my opening paragraph and point out that there is no more definite lesson from history than that the military authorities of a nation should not be master of its policies either directly or indirectly. This is not a new challenge. It has confronted civilization at the close of most wars in modern times. I do not anticipate any serious difficulty in this regard in our own country but we must be mindful of the situation—and of the dangers to freedom which have always occurred where the problem of security takes the upper hand over that of human welfare.

Senate Hearings On Atomic Energy . . . . . .

• • • •

The hearings before the Senate Special Committee on Atomic Energy continued through most of February. In the last issue of this bulletin, we published detailed reports on testimony bearing most directly on the controversial subject of military vs. civilian control—by the Secretary of War Patterson, and by General Groves. The statements of Profs. Teller and Ridenour, dealing with the crippling effect of secrecy regulations on the advancement of science, were also reprinted in the same issue.

Among the other statements, presented during this period, were those by several industrial witnesses — J. D. Rafferty of Union Carbide and Carbon on February 7, G. Folk of the National Association of Manufacturers, and E. Bransome and F. Kett of the Vanadium Corporation on February 8, A. C. Klein of Stone and Webster, and B. Manly of Southern Gas on February 13, and J. C. Parker of Consolidated Edison on February 18. On the whole, representatives of the companies which had actively participated in the Manhattan Project favored the McMahon bill. These industrialists acknowledged the necessity of government monopoly of fissionable materials and agreed to the principle of national ownership of patents obtained in the course of government-sponsored development. A different point of view was taken only by the representative of the NAM, George Folk, who described the McMahon bill as a threat to private enterprise and requested that government activity in the field of atomic energy be restricted to the protection of the public from health hazards and explosion danger. Displaying little knowledge of the subject, he spoke of "new harmless fissionable materials" which are likely to be discovered and may find applications in industry without constituting a danger to the public.

On February 15, the committee witnessed a "round table" discussion on the subject of the destructive effects of the atomic bomb, with Major de Seversky facing a "united front" of scientists (represented by P. Morrison) and the Army, represented by T. A. Farrell, S. Warren, F. D'Olier and P. A. Nitze. We will treat this subject in our next issues.

Below, we give a summary of testimony on two special topics. One is the patent situation on the Atomic Bomb Project, and the other the attitude of the utilities towards the possible utilization of atomic power.

ATOMIC BOMB PATENTS

The testimony of Mr. Stewart and Capt. Lavender on February 11 brought the first authentic disclosure of the patent situation on the Atomic Bomb Project. Following is a condensation of the two witnesses and of the ensuing questions and answers.

PATENTS POLICY UNDER THE OSRD

Irving Stewart (Deputy Director, Office of Scientific Research and Development)

Research and development in the field of atomic fission was a responsibility first of the NDRC, and then of the OSRD, until the end of April, 1943, at which time the Manhattan District took over.

In its contracts OSRD used two patent clauses. The short form gave the Government the power to determine the disposition of all rights in discoveries and inventions made under the contracts. A number of vitally needed industrial organizations were unwilling to accept such a provision. This resulted in the adoption of the so-called long form. It left with the contractor the title to inventions, subject to a license in favor of the Government for national defense purposes.

The short form clause was used where the Government assembled a group of men to work in a field where enough information was not available in a single organization as, for example, in the Radiation Laboratory at the Massachusetts Institute of Technology.

When the program on atomic fission was taken over by NDRC, the initial contracts were executed with organizations which already had done work in that or related fields. These contracts contained the long clause. As the project grew, and the tremendous possibilities began to take shape, it was decided, in spring of 1942, that Government control should be strengthened through changed handling of patent rights.

The Standard Oil agreed to give the Government full control over inventions and discoveries. Thereafter Columbia University, Westinghouse, the M. W. Kellogg Company, the University of Chicago, the duPont Company, the University of California, and the other OSRD contractors all agreed to accept a retroactive change to the short form.

The result is that, under all NDRC and OSRD research and development contracts, the Government received the right to determine the disposition of all patents.

If the OSRD decided that no patent application should be filed on behalf of the Government, the Contractor could file in its own behalf with the understanding that he would grant to the Government a non-exclusive, royalty-free license for governmental purposes.

For inventions and discoveries in the atomic fission project, the general policy was established of vesting title to patents in the Government.

Senator Millikin: Without consideration?

Mr. Stewart: Without consideration, yes; and I can state flatly that there has been no consideration in any case.

PATENTS POLICY UNDER THE MANHATTAN DISTRICT

Captain Lavender (Advisor on patent matters to OSRD)

In addition to carrying on research and development, the Manhattan District had to make contracts for the quantity production of equipment.

Four patent clauses were used in the Manhattan District contracts:

(1) For research contracts we retained the regular short form patent clause.

(2) Sometimes this clause was modified, so that the contractor could retain a non-exclusive license in the outfield. I mean by "outfield" commercial activities, and by "infield" any device, apparatus or process that is used in the atomic energy program. That clause was used where some information was given to the contractor as to the research work that had been done.

(3) In the third type of contract, the contractor retained the sole license with the right to grant sub-licenses. That contract was used where we went to a contractor in his own field of development, but there was some engineering or redesign for the particular work that we were engaged in.

(4) The fourth group of contracts covers cases where the purchases are off the shelf, and a time was necessary ordinarily to investigate the patents that may be involved in this equipment. The clause provided that the Government would assume liability for infringement of patents. However, where we purchased equipment in which the manufacturer had had extensive experience this liability was assumed by the contractor.

Senator Millikin: Might a patent application give clues as to things that we might not want to reveal?

Captain Lavender: Those applications are still in the Patent Office. The Govern-

(Continued on page 11)

Senate Hearings - Atomic Bomb Patents . . . . *Continued*

(Continued from page 10)

ment has full control as to when they are going to be released.

Senator Millikin: By what authority does the Government impose a wall of secrecy around an application?

Captain Lavender: 35 U. S. Code 37 says that when the title of an invention is in the Government, the six months that are given for an applicant to respond shall be extended to three years; a claim can be in the application which would not be allowable, so that it is rejected again and then another three years is given. This is the machinery by which Government can control the date of issue of a patent.

Senator Millikin: Suppose I today filed an application covering the same subject matter as one of these impounded applications. What explanation would the Patent Office make to me?

Captain Lavender: There is a law that during the emergency the Patent Office may issue orders of secrecy.

Senator Millikin: The justification, in other words, is a matter of wartime necessity?

Captain Lavender: That is right.

The Chairman: Are there any applications in the Patent Office by private companies on atomic fission?

Captain Lavender: There are some that have been filed by independent inventors.

The Chairman: How about applications for "atomic energy devices?" Have any of these been filed by contracting firms?

Captain Lavender: No, we have filed all such applications.

The Chairman: Have they retained—any contractor—any claim to (a) the production of fissionable material, or (b) the application of fissionable material to atomic energy devices in the future?

Captain Lavender: No contractor has retained any right to such inventions.

Senator Millikin: How many people have access to applications impounded in the Patent Office?

Captain Lavender: The Chief Examiner and his assistant were the only ones designated by the Commissioner of Patents to handle those cases. They are kept in separate safes in the Patent Office.

The Chairman: Are there any patent applications giving the bomb making details in those patent applications?

Captain Lavender: The bombs are covered by applications.

The Chairman: I didn't dream, frankly, that there was a patent application down there showing how the bomb was put together.

Captain Lavender: I was reserving for the executive session the special handling of applications relating to bombs, which I am sure fully safeguards it.

The Chairman: Have there been any applications from foreign inventors on atomic bombs?

Captain Lavender: What they contain I do not know, but there are quite a good many applications by foreign inventors. There was one patent that had already been issued in France in the fall of 1939, which was filed over here a little over a year later and is still pending.

Senator Millikin: Would any of these contractors to whom you refer have refused to go ahead with their work had they not been given some patent right?

Captain Lavender: I don't know of a single company that ever said, "We are not going to do anything until we get all of these contract rights worked out."

Senator Millikin: Then those privileges are sort of a gratuity we have given them?

Captain Lavender: If we said, "We want the whole thing and you retain nothing", it would be natural for the Government to pay for all of the invention rights. Purely from a business point of view, we don't take more than we need.

Senator Millikin: Let us suppose that John Doe is a little fellow making a valve and Richard Roe is a big fellow making a valve, and you picked Richard Roe as the man to do a job for you. Now comes peace, and Richard Roe appears with a lot of improvements. Where does that leave this little fellow, John Doe?

Captain Lavender: The Government has the title to the invention, and can grant a license to the small man.

The Chairman: But is not the great bulk of the patent applications in the field where the outside company has an exclusive right?

Captain Lavender: These are inventions of the "third category", which are of not much importance.

The Chairman: If an individual or a company works in the atomic energy field at his own expense, there would be no way that you could get hold of it?

Captain Lavender: There is one part of the Espionage Act, which requires that information involving national defense come as a result of some relation with the Government. The Government could go to the inventor and place him under the Espionage Act, and he would not be permitted to disclose his invention. The Commissioner of Patents may be authorized and directed to notify the Atomic Energy Commission of the existence of an application in which reference is made to atomic energy, then the Commission should have authority to go to him and purchase it or make some other arrangement. This is in effect the seizing of the invention and restricting the inventor under police power.

The Chairman: That wouldn't change his ownership, but merely his right to divulge it?

Captain Lavender: That is right.

The Chairman: You would have to pay some compensation, I take it?

Captain Lavender: You could offer the compensation, but I think it would come under police power rather than eminent domain.

The Chairman: So Jones might make the greatest invention in the field and be deprived of any award for it?

Captain Levender: If he did not want to accept the award that was offered to him.

A person who has a patent cannot obtain from the Government the facts concerning the equipment that corresponds to his patent, if the Army and Navy do not desire to disclose it. The Court of Claims will not enforce a call for information against the Navy Department if the Navy certifies it involves the national defense. That leaves the claimant in the Court of Claims with a perfectly valid patent but no way to prove his case.

Senator Millikin: What do you know about the patent applications of Kellex?

Captain Lavender: The Kellex has granted a license to the Government under all of the patents developed before the date of the contract, that may be used in any of the plants.

As to the present conditions, they started out with a long form clause which was renegotiated to a short form.

Senator Millikin: Are those of enormous value, those exclusive license rights?

Captain Lavender: The license rights are non-exclusive, so the Government can grant licenses to other companies.

The Chairman: I believe duPont has made no claims at all for improvements or inventions.

Captain Lavender: duPont said they didn't want to have anything to do with the determination as to who inventors were. The Manhattan District took the responsibility of ferreting out the inventors. They were working with the University of Chicago, and they didn't want to let anybody think that duPont was going to grab up any of the patents.

Senator Millikin: But assuming that you fellows determine that a duPont man has made the invention, then what happens?

Captain Lavender: Then we will do our part to cooperate to get the application executed.

Senator Millikin: But what right would duPont then have in the application?

Captain Lavender: None.

The Public Utilities And Atomic Power . . . . . At

The following is a summary of the testimony before the Senate Committee, of John C. Parker, Chairman of Special Committee on Appraisal of Atomic Energy of the Assoc. of Edison Illuminating Co's.

The Committee proposes to avoid inquiry into the specific technique of the processing of fissionable materials. However, the appraisal would be aided by knowledge of the economic factors surrounding the materials involved in energy production by atomic fission, which we do not now possess in more than the most rudimentary degree.

It appears now that the two most likely fields of energy utilization are to be found in marine propulsion and in large land power plants. The committee, therefore, proposes to offer to the United States Navy such collaboration as the Navy finds to be consistent with the purposes of national security. It is believed that the committee can, through its familiarity with the problem of power plant design, construction and operation, be of some appreciable service to the naval authorities. It is quite possible, as was the case with higher pressure and higher temperature steam development, that large land installations may afford an excellent proving-ground for the exacting requirements of the Naval Service.

LARGE REDUCTION IN POWER COSTS NOT FORSEEN

It is proper to point out that zealously though the industry will seek to develop the possibilities, revolutionary results in the cost of supplying the public are not to be expected but rather sober, level-headed betterment. The reason for that is worth pointing out.

Most of the investment and much of the operating cost of present systems lie outside the generating plants—for example, in the distributing systems and in the multifarious services to customers.

It is evident, if this preliminary hypothesis proves correct, that the primary advantage to the national economy through the use of nuclear energy will be in the service of that part of the utility load in which fuel costs play the relatively biggest part, namely, industrial and heavy traction load, and that the economics here will probably be not much greater than the difference in fuel cost.

There has been some popular misconception as to the amount of energy that would become available through atomic processes. A clear perspective in this matter is to be had from a realization that never at any time has the country suffered from a deficiency in the amount of power available. Indeed it seems clear that the ultimate supply of energy available from coal and from water-power is more than sufficient for all the probable needs of the country for centuries to come. All that is necessary to expand the availability of electrical power is the construction of plants, transmission and distribution systems. Even more significant, however, are the much more expensive plants and devices for utilization. All this will be the case whether the source of energy is the atom or the more conventional sources. It is true that some expansion of electric energy use may result from the development of atomic energy in so far as such development brings about a reduction in cost of generation, and therefore makes possible the electrification of certain large scale chemical or metallurgical processes now carried out on a directly thermal basis. But that, if at all, will occur only after an extended period of time and as it proves economical.

OBSOLESCENCE OF PRESENT PLANTS NOT SERIOUS

Another popular misconception is that public utilities might be unduly apprehensive of the obsolescence of their plant. If nuclear energy will be used in the production of steam for high temperature turbines, the process will be analogous to a current one quite common to the light and power industry, namely, the use of so-called topping turbines. When new and more efficient heat cycles, using much higher steam pressures, and temperatures, became available, the utility companies recognized the possibility of removing some or all of their older boilers, of producing steam at high temperature and high pressure and then, in new turbo-generator sets, while doing useful work, degrading it to the level formerly produced in the lower pressure, lower temperature boilers and further using it in the existing turbines. A strictly analogous process seems quite probable when and if the technical and economic problems of atomic energy utilization are worked out. Old boiler plant and combustion equipment may be removed, giving place to the new type of boiler, with or without its own high pressure, high temperature turbine. Thus steam would be produced for use in the present turbo-generators either directly or through the intervention of an atomic topping turbine.

Senator Austin: What is meant by "topping"?

Mr. Parker: When it became possible to build steam turbines with their associated generators operating at temperatures of the order of magnitude of 950 to 1,000 degrees, and at pressures running up to 2,500 pounds to the square inch, relatively small turbines of that character were produced which, after having done useful work in driving the electrical generators, exhausted their steam at more moderate pressures and temperatures, generally at the temperatures and pressures previously used in the stations into which these new turbines were to be installed. These turbines were high-speed relatively small units with their boilers, and where they were installed did about half of the useful work of making electrical energy, discharged their steam—still capable of doing a great deal of useful work—into the older equipment which didn't any more have boilers for supplying them directly, and then roughly an equal amount of work was done in those lower pressure, lower temperature turbo generators.

ATTITUDE OF UTILITIES ON LEGISLATION

In this connection the public utility industry of the country has only one reservation and that is that atomic materials should be available for industrial use without differentiation as to the type of utility to which it is made available and with the single collateral requirement that any resultant net economies be passed on to the consumers.

We completely endorse the theory that the processing of such materials must be under the control of some such commission as it is proposed in the McMahon bill (S. 1717). The possibilities of misuse under any other scheme of production are too ghastly to be contemplated. As a collateral of such control, licenses for use seem quite inevitable.

It seems perfectly clear to me that for any body of individual citizens without the most compelling restraints to have possession of the processes of production of materials which have demonstrated their capacity to two Japanese towns just would be a complete subversion of every element of public safety.

The Association of Edison Illuminating Companies regards as of distinctly minor significance any question of patent rights that may result from the studies of this committee or subsequent development committees.

The large scale technique of promotion of the scientific knowledge had been at the expense of the people of the country as a whole. $2,000,000,000 of the resources of the country have been put into this thing. Now, it does seem perfectly clear that whatever may be the active agent in the further production of fissionable material, the control of a thing created by the people of the nation must rest in the people of the nation.

Atomic Power Production . . . . . *Farrington Daniels*

The energy of an atomic bomb can be used either to furnish heat, light, and power to a city—or to destroy the city. By simple control mechanisms the energy may be released gently over periods of days, months or years—or it may be released with explosive violence in less than a millionth of a second.

Conflicting statements about the practical uses of atomic power have been made by different scientists, depending largely upon whether a short-range view or a long-term view is taken. It is fair to say, however, that the outlook for future usefulness was probably no brighter for the first steam engine and the first electric motor than it is now for the first power pile.

A "pile" is made by simply stacking up uranium or uranium-235 or plutonium with a moderator of graphite or other suitable material which slows down the neutrons so that they will be better absorbed in the uranium. The pile must not be less than a definite critical size, otherwise the external loss of neutrons will be so great as to prevent the continuation of the nuclear chain reaction. Enormous quantities of heat are released by the fission process taking place within the pile.

The complete disintegration or "fission" of one pound of uranium-235 results in the actual loss of one thousandth of a pound of matter, and according to the Einstein law this loss is accompanied by the evolution of eleven and a half million kilowatt hours of heat. If this heat is used with standard boilers, engines and dynamos, it can be converted into about three million kilowatt hours of electricity.

POWER PILES ARE TECHNICALLY FEASIBLE

With adequate support a pile could be built and a good-sized turbine and dynamo could be operated with atomic power within a year. Until recently all effort on piles was directed toward producing plutonium for bombs. All other considerations were neglected. It did not matter if large quantities of heat were utilized only for raising the temperature of the air over Tennessee or heating the water of the Columbia river. For the sake of simplicity these piles were operated at low temperature, under conditions such that the heat is not suitable for conversion into useful power. But the pile can give off its heat just as well at high temperatures, where the large temperature difference is effective in producing power, just as a high waterfall is effective for water power. The only limitation in high-temperature operation of a pile is the ability of the materials of construction to withstand the temperatures generated. This is a serious limitation which is already holding back the improvement of ordinary gas turbines.

A gas or liquid can be circulated through a heat interchanger which then boils water or other liquid to drive a turbine or standard engine. Assuming a tight heat interchanger, this secondary system is not then contaminated with radioactivity.

Hot gas swept through the pile can be used directly for driving a turbine. If the uranium is covered tightly to confine the fission products, an open-cycle turbine can be used in which the gas is allowed to escape—otherwise a closed-cycle turbine is necessary.

POWER PILES INVOLVE UNIQUE AND SERIOUS HAZARDS

In the fission process neutrons and penetrating gamma rays, similar to X rays, are given off at enormously great intensities. It is necessary to surround the pile with walls of concrete several feet thick in order to protect the health of the operators. The new radioactive elements produced by the fission of uranium or plutonium may be either solids or gases with decay periods of varying lengths. Since they can not be discharged into the air nor dumped out as ordinary waste, they must be retained in gas-tight enclosures. If they are allowed to mix with the cooling material which circulates between the pile and a heat interchanger, the radioactivity will be so serious as to destroy any organic material such as lubricating oil which may be in or near the circulating system. Ordinary repairs are impossible because workmen can not come near, and ingenious replacements by remote control must be devised.

If a pile should suffer an accident which scattered the material of the pile, a serious situation would be created, because no one could approach the scene for months to clean up the material.

There is no chance of an explosion of a power pile similar to an atomic bomb explosion, but if a large pile should ever get out of control it might heat up unduly and spread some radioactive material over the immediate surroundings.

There is no danger that the energy liberated in piles can touch off nuclear chain reactions involving the light elements in such a way as to lead to an atomic catastrophe which would destroy the earth or any part of it.

PRESENT ATOMIC FUEL IS MORE EXPENSIVE THAN ORDINARY FUEL

One pound of uranium-235, occupying only a little more than a cubic inch will give on fission as much heat as a trainload of 1500 tons of coal worth $7000. It takes 140 pounds of ordinary uranium to give one pound of uranium-235 and the cost of this much uranium is considerably less than $7000. However, when ordinary uranium is used in piles, the piles have to be of very large size and only a fraction of the uranium-235 can be fully utilized. More successful results can be obtained with pure or enriched uranium-235 or plutonium. The separation process, however, greatly increases the cost of the pure isotopic fuel.

It has been estimated that pure plutonium or uranium-235 must sell for $25,000 per gram to compete economically with coal, and for $50,000 per gram to compete with gasoline. The cost of production of plutonium and uranium-235 is considerably more than this—and yet the difference is not so great that all thought of future economic utilization of atomic power should be disregarded.

Another important item of cost is the chemical purification and recovery of the spent uranium. The accumulation of fission products poisons the pile and requires a change of atomic fuel.

It must be emphasized that the cost of fuel is only about one-fifth of the total cost of producing electricity for domestic purposes in locations where coal is easily available. The cost of distribution is much more and this cost is not affected at all by substitution of atomic power for coal. In other words, if atomic power could be obtained free the maximum possible saving could be only 20 percent. By the same reasoning, however, if one paid twice as much for atomic power as for coal, the cost of electricity produced would be increased by only 20%.

The shielding, the controls, the arrangements for operation at a distance, the precautions for health protection and the plant required for recovery and disposal all constitute large fixed charges which are not found in the standard power plants using combustion of coal or waterpower. Moreover, the amount of uranium-235 or plutonium used must be much larger than the amount consumed because the pile will not continue to operate after so much material has undergone fission as to reduce the pile to less than the critical size.

In isolated regions where transportation is difficult one doesn't count dollar values. If one chooses to build a city at the north pole one must have heat and power regardless of cost.

In Argentina, southern China and Mediterranean regions there are demands for power and heat but neither coal nor water power is available. These regions might properly look to nuclear power. It is com-

(Continued on page 14)

Can Air or Water Be Exploded?

(Continued from page 2)

between light nuclei at low energies. In some cases, like the reaction between two deuterons, direct experimental investigations have been carried to very low energies. The greatest danger in making theoretical estimates at low energies seems to be the possibility of some resonance in this region. However, the calculations can easily be done, taking into account a resonance of the greatest possible strength, and even then the result is many powers of 10 below the possibility of a chain reaction.

Moreover, we have the experience of the stars to go by. All the elements abundant in water or in the atmosphere are also abundant in stars. If their nuclei were capable of reacting with high probability at any temperature up to 20,000,000°, this reaction would certainly occur in the stars and would consume the elements in question or greatly increase the energy production. This argument has the weakness that our concept of the exact temperature distribution in the stars is itself based on theoretical considerations. The astrophysical argument, therefore, should only be regarded as supplementary evidence, supporting the theoretical calculations based on quantum mechanics.

It appears, then, that atomic bombs of present construction are safe by enormous margins against igniting either the atmosphere or the water or the earth. There are good reasons to believe that even any conceivable future improvements of the bombs will still be safe in this respect. However, before any test of such an improved bomb, a detailed consideration, taking into account the particular features of the future bomb, will be absolutely essential.

It seems to me that the objection to the Navy test does not lie in the possibility of setting the ocean on fire. The objections which we, as scientists, have are concerned with the problematical significance of the first two tests as planned. This criticism has been thoroughly discussed in this Bulletin in the issue of February 15. We now hear with especially great concern that there are some discussions of abandoning the third test of the bomb, the one under water, which is the only test which can be regarded as significant. If this were done, it would be far better to abandon also the first two tests which will only serve to mislead the public as to the effects of the atomic bomb on ships.

More important still, let us not forget that over and above the Navy tests and the problem of igniting the ocean, there is one problem which is of really overwhelming concern to us all: the problem of international control of the bomb. While some scientists may argue that there might be a remote chance of our concepts of theoretical physics being false at some point which might invalidate our predictions, they will all agree that there is an immeasurably greater danger that the peoples of the world will not have sufficient wisdom to settle their differences before a war breaks out which will be fought with atomic weapons. To draw everybody's attention to this possible catastrophe has been, and still is, the main concern of all of us.

Atomic Power Production

(Continued from page 13)

forting too to realize that after man squanders all his coal and oil he can still keep himself warm for a few centuries more with uranium.

Atomic power can be used to drive ships which will not have to be refueled for long periods of time, but the application to automobiles or small mobile units does not seem likely.

Extravagant statements have been made such as "There is enough energy in a breath of air to propel an airplane." If one refers to the theoretical and complete annihilation of ordinary matter this might be true, but this annihilation has not yet been accomplished, and the only large-scale production of atomic energy involves the "chain-reacting" fission of uranium or plutonium.

CONCLUSIONS

Using piles similar to those now built, atomic energy cannot be used economically in this country in competition with coal. There is no chance that atomic power will render obsolete any of our present power-producing equipment within a period of at least ten years. New developments may bring the cost of atomic power down to a point where it can supplement coal and water-power. Intensive and unhampered research by scientists and industrial companies should be encouraged. Since the cost of fuel in this country is only about one-fifth of the total cost of generating electricity, no revolutionary reduction in cost could be expected even if atomic power should become cheaper than coal.

It is true that if all thought of application of atomic power for useful purposes were abandoned there would be no upset in our present economic system and the control of atomic bombs for military purposes would be greatly simplified. Yet it would be a pity if man should have to deny himself important resources which nature has given him—simply because he can not find a way to eliminate war and the causes of war.

Resolutions Request Cessation of Bomb Production

The Executive Committee of the **American Association for the United Nations** (Chairman: Dr. William Emerson, director: Clark M. Eichelberger) has released a statement which urges, among other political measures, the cessation of stockpiling of atomic bombs, and admission of representatives of the UNO Atomic Energy Commission to the forthcoming Navy tests.

The **Federal Council of Churches of Christ** representing 25 million Protestant churchgoers, met at Columbus, Ohio, under the chairmanship of Bishop Bromley Oxnam, and adopted a resolution regretting the use of atomic bombs on Japanese cities and asking that Hiroshima and Nagasaki be rebuilt by the American people as a sign of repentance and good will. This resolution was later severely criticized in the press by a group of participants.

The Council also resolved to urge the immediate cessation of atomic bomb production by the Army—this despite a telegram from Dr. A. H. Compton, who insisted that it is the duty of America to arm both for its own security and for that of smaller nations unable to protect themselves.

ROLLINS COLLEGE CONFERENCE

A conference to "discuss and recommend the formation of a type of world government adequate for the control of atomic bombs and other super-weapons" started on March 11 at Rollins College in Winter Park, Florida. It will continue through March 15.

Participating were Profs. Samuel K. Allison and Harold C. Urey of the Institute of Nuclear Studies, University of Chicago; I. I. Rabi of Columbia University, and Henry D. Smyth of Princeton University; the Rev. E. A. Conway, S. J., of the Catholic Association for International Peace; Rabbi Louis L. Mann of Chicago; W. T. Holliday, president of the Standard Oil Company of Ohio; Carl Van Doren; Prof. Preston Slosson of the University of Michigan; James Carey, secretary-treasurer of the Congress of Industrial Organizations, and Emery Reves, author.

BRITISH FOREIGN POLICY AND THE BOMB

The possibility of a reorientation of British foreign policy in the event of a stalemate in the UNO discussions on the international control of the atomic bomb is intimated by two articles in **The Political Quarterly** (Jan.-March 1946, vol. XVII No.1). **The Political Quarterly** is the most important British journal devoted to the discussion of political affairs from the Labour and Liberal standpoints. The Editor is Leonard Woolf, Secretary of the Labour Party's Advisory Committee on Colonial and Imperial questions and one of the Party's elder statesmen.

The two articles are by Leonard Woolf ("Britain in the Atomic Age") and Richard H. S. Crossman ("Britain and Western Europe"). Both authors start from the premise that Britain would be indefensible in an atomic bomb war. Woolf says "Ten atomic bombs would be sufficient to wipe London off the map. With that fact in mind and a map of Great Britain, it is not difficult to see that no country in the world is more vulnerable than Britain to the new weapon. The concentration of our population in great industrial cities and our inability to live unless we keep our ports open and working, mean that the whole country would be virtually wiped off the map within a week if we were combatants in a European war waged with that weapon." Crossman is equally explicit: "However courageous we showed ourselves, the next world war would bring with it in its first week the destruction of the Capital of the Commonwealth and of the ports through which we receive our food."

Mr. Woolf was a vigorous proponent of the League of Nations and he still remains completely free of any taint of nationalism or imperialism. But he is critical of Mr. Bevin's view that "all that one has to do is to go on building the United Nations Organization." "The atomic bomb has made the UNO as developed at Dumbarton Oaks and San Francisco, out of date, antediluvian." As long as there is any chance, according to Mr. Woolf, for an aggressor nation to obtain atomic bombs, then so much destruction could be wrought that the retaliatory powers of the rest of the UNO would do little more than add to the holocaust. "It follows that nothing can save civilization if the existing international system of sovereign national states continues, for its destruction is inevitable if any sovereign state remains free to manufacture, arm itself and use the atomic bomb." There is little hope that the bomb could be outlawed effectively. "States, or rather men politically, are so barbarous that if governments can manufacture and possess these bombs, states will manufacture and possess and ultimately use them. International control of national use of atomic energy, if it is limited to international inspection to see that atomic energy is not used for military purposes and the manufacture of military weapons, cannot be effective." From this Mr. Woolf concludes that the production of atomic energy must be in the hands of a world authority and that furthermore, all other major weapons must also be in the hands of a similar authority. This in turn might entail restriction of national sovereignty with respect to economic development. Mr. Woolf does not shrink from this prospect.

So far, Mr. Woolf's line of argument follows the Bevin-Eden statements for world government of November 22-23, 1945. But suppose the world government cannot be established? Mr. Woolf does not discuss the alternative and it is at this point that Mr. Crossman takes over the discussion. Mr. Crossman is about a generation younger than Mr. Woolf, but he continues in the same intellectual tradition of British Socialism; he is a political scientist and philosopher on the faculty of Oxford University, he is now MP for Coventry, and member of the Anglo-American Palestine Commission, Assistant Editor of **The New Statesman and the Nation** and on the Editorial Board of **The Political Quarterly.** During the war he held an important post connected with the Foreign Office and he must be regarded as the most outstanding specialist on Foreign Affairs among the new Labour MP's. His views are listened to with respect and endorsement by the vigorous group of Labour back-benchers who often dissent from the policies of the Government and who are likely to increase their influence in the Government in the near future.

Mr. Crossman has less optimism about world government than Mr. Woolf, and starting from the military premises already quoted, he proceeds to the conclusion that Britain's solution is to be found in a Western European Union. He carefully insists that it would not be anti-Soviet nor would it be dominated by Britain. It would be a union for economic collaboration. He also takes pains to make clear that it would not depend on American armed might. (The desire for British independence from American foreign policy is widespread in his group.) "Indeed," Crossman says, "if it is to gain both British and American confidence, its members must make clear that they would be neutral in any third world war, whatever the cost to British declaration of neutrality in event of a Soviet-American conflict has already been proposed in the **New Statesman and Nation.** As one Labour party intellectual humorously describing the incipient British trend toward neutrality said: "When the U.S. & Russia go to war, Britain will offer America all aid short of war."

Such a Western European union would be a far cry from Mr. Churchill's Anglo-American Association — it would be a break-up in the present loosely knit strategic Alliance between the United States and Great Britain. At present the demand for a neutralized Western Union is still small in the top order of the Labour Party but it is both considerable and increasing among Labour back benchers. An intensification of the threat of war with Soviet Russia is likely to cause an increase in it, and, this attitude might become a significant factor in British foreign policy.

E. S.

Moral Responsibilities of Scientists

(Continued from page 3)

achieve it only the future can show, but it is worth trying. It will not make headlines in the papers: immorality alas, not morality, is 'news'. Those who fancy themselves as hardboiled realists, as the 'practical men' who practice the errors of their forefathers, may deride us and our principles. But the truest form of realism is to recognize that human well being, indeed the continued existence of human society, depends more on improvement of morality and reasonableness than on invention of machinery or organization. We scientists, few and insignificant as we may be, have provided mankind with the knowledge and the tools, physical and biological, either for mutual destruction and elimination, or for an improvement in health, welfare and happiness beyond all previous experience. Let us try to supply, by our example, a common standard of ethical behavior and of courageous insistence on collaboration, so that man can then decide, with his eyes open, which of those alternatives he will choose.

FIRST MEMBER OF THE UNO ATOMIC COMMISSION APPOINTED

Sir Alexander Cadogan, permanent Under Secretary of the British Foreign Office and Britain's representative on the UNO Security Council, has been appointed to represent Britain on the Atomic Energy Commission. As his alternate, the British Government has appointed Sir James Chadwick, the discoverer of the neutron.

We hope that other nations will follow Britain's example in giving representation on the UNO Atomic Energy Commission to scientists.

The American delegate to this Commission has not yet been appointed.

The Bulletin of the Atomic Scientists

The title of this publication has been altered to **The Bulletin of the Atomic Scientists.** It previously was called **The Bulletin of the Atomic Scientists of Chicago.** The change is in response to recommendations made to the ASC from other site groups. It corresponds to the increasingly broad nature of the contents of, and the wider geographical distribution of the contributors to, the Bulletin. Editorship and sponsorship remain unaltered.

The Bulletin is now on a subscription basis—one dollar for six months; two dollars a year. Further financial aid towards improving the content, format and distribution is welcomed.

The space expansion in the Bulletin has been from 6 to 16 pages in seven issues; the distribution has increased by a factor of twenty in the first six issues.

The editors invite suggestions and comments. Contributed articles should be addressed to H. H. Goldsmith, Atomic Scientists of Chicago, 1126 E. 59 St., Chicago 37, Ill.

NOTES ON CONTRIBUTORS

H. A. Bethe is Prof. of Physics at Cornell University. He directed the work in theoretical physics at Los Alamos during the war.

E. U. Condon is President of the American Physical Society, Director of the Bureau of Standards, and Scientific Adviser to the Senate Special Committee on Atomic Energy.

Farrington Daniels is Prof. of Chemistry at the University of Wisconsin and Director of the Metallurgical Laboratory at the University of Chicago.

S. A. Goudsmit is Prof. of Physics at the University of Michigan. Associated with the Radiation Laboratory at M.I.T. during the war, he led a scientific mission which studied the German atomic energy program.

A. V. Hill is one of the world's leading physiologists and past-president of the Royal Society.

James T. Shotwell is Chairman of the Carnegie Endowment for International Peace.

CIVILIAN VS. MILITARY CONTROL

(Continued from page 1)

such actions or proposed actions of the commission to the President, whose decisions shall be final."

Senator Vandenberg claims that this proposal leaves all power with the civilian Commission, and merely allows the military to interfere whenever it feels that the interests of national defense are threatened by action (or inaction) of the Commission. When President Truman, on March 13 confirmed his support for civilian control as envisaged in the McMahon bill, but added that "the military had an important part to play and should be consulted"—Senator Vandenberg said that that describes his proposal "exactly." Why then are the proponents of civilian control still alarmed? Why did Senator Millikan vote for Vandenberg's proposal and Senator McMahon against it, and not the other way around?

The answer is that Vandenberg's proposal leaves it up to the military board to determine what is of concern to "national defense and security." This gives it the right—or rather, the duty—to try to impose its concept of security upon as wide an area of fundamental research as possible. In other words, the military advisory board is certain to attempt a continuation of the Manhattan District policy of secrecy and compartmentalization.

The reason why a military board cannot but try to carve out the largest possible chunk out of the living body of science, is because they don't understand it, and therefore have to "play safe." How can they know what field of nuclear research (or any other branch of natural science) is "important for national defense?" After all, it was not the military who first guessed the explosive potentialities of atomic fission in 1939!

Nations are accustomed to looking to their military men whenever their security is endangered. The revolutionary fact of the present situation is that military have ceased to be experts on security. In fact, they can offer no security. Some of them — like General Arnold — freely acknowledge it. But the spokesmen of the Army and Navy do not feel like coming to the Congress and saying: "You have entrusted us with guarding the security of the American nation. We have to return the mandate, because we cannot fulfil it. There is no security for a nation in the world of atomic armaments." Instead, they proclaim themselves guardians of secrets in which fictitious security is supposed to reside. This is the dangerous delusion which the scientists are fighting when they oppose the apparently innocent right of the military to "advise and consult" with the Atomic Energy Commission.

The testimony of the Federation of Atomic Scientists before the McMahon Committee, presented on January 28, clearly stated that the scientists "do not exclude efficient liaison between the Atomic Energy Commission and the military. Provision to make this liaison mandatory will not be opposed by them." Neither do the scientists object to the Army undertaking research and development of atomic ordnance. But they do oppose the extension of Army control into the field of fundamental science under the pretext of guarding "secrets vital for national security." It was Secretary of War Patterson himself who stated before the McMahon Committee that the military are not competent to draw the line between basic research and its military applications, and that this is one of the policy decisions which must be left entirely in the hands of the Civilian Commission.

ATOMIC SCIENTISTS OF CHICAGO

Office: 1126 E. 59th St., Chicago, Ill., Tel. MIDay 0800, Ext. 1785.

Executive Committee:
J. A. Simpson Jr. (chairman)
A. Brues, F. L. Friedman, A. H. Jaffey, R. J. Moon, J. J. Nickson, E. Rabinowitch, Alternates: R. M. Adams, M. S. Freedman, L. I. Katzin, A. Wattenberg, Secretary to the Executive Committee: H. H. Goldsmith.

Advisory Committee:
T. R. Hogness (chairman)
S. K. Allison, W. Bartky, K. C. Cole, F. Daniels, J. Franck, S. Freed, W. S. Johnson, R. S. Mulliken, G. Seaborg, L. Szilard, H. C. Urey, W. H. Zachariasen, W. H. Zinn.

Publicity Committee:
K. Way (chairman)

Materials Committee:
L. I. Katzin (chairman)

Speakers Bureau:
A. S. Langsdorf

Library and Records:
R. L. Platzman
(Room 258, Ryerson Hall)

BULLETIN OF THE ATOMIC SCIENTISTS

EDITORS:

H. H. Goldsmith E. Rabinowitch

The Bulletin is published twice a month by The Atomic Scientists of Chicago. Single copy—10c; subscription price —$1 for 6 months; $2 a year. Special rates for groups. It is sent on request to those interested in atomic energy. Contributions toward defraying cost of publication are welcomed.